

Database Management for Event Organization

Nicholas Tiveron (1936848) and Yusupha Juwara (1936515)

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Overview

EventOrg is a hypothetical company whose goal is to provide to the public the best experience possible when wanting to host an event. Since organizing any sort of event or get together can be troublesome and is the least fun part of the experience, EventOrg allows its customers to select the criteria for their ideal rendez-vous and handles all the vicissitudes that come with organizing an event, so that they just have to worry about enjoying their time.

The customers can also choose the food and drinks they want among the other options that they have for their events.

The company EventOrg asked us to represent their internal structure with a database and ultimately to create a product through which their clients could book an event, just the way they wanted.

For the people that interact in some way with our company we identify them by their Social Security Number and we want to represent their first name, last name, email, age and sex.

The three main groups we want to represent are special clients, directors and organizers (who also work as DJs in those events that require it).

Clients can use coupons, identified by a code, to get a discount on a specific booking of their choice of an event type (specified by the type attribute). The coupons have a date when they can start to be used (when they are obtained by the customer) and an expiration date, after which they will no longer be able to be used.

For directors, we are interested in their salary and the date we hired them.

For the organizers, we want to know their salary, the date we hired them and their license. Each organizer is assigned to at least one of the sites that can be booked by clients.

All the people live in a city identified by its name and the name of the county where it's located but other important information is the region where the city is.

Every person is born in a city which doesn't have to be the one where they currently live in and they can book an accommodation (that has a unique ID) in a city which can in turn be different from the others. The accommodation has an address (street name + civic number + zip code), a cost and is identified by its name and the city where it is located. They can be of three types: hotel, which may have facilities (such as a gym, a pool, a spa, etc.), hostel and bed and breakfast.

When a customer books an event they can choose to have food served while they are having fun. Each order has a unique code and all the items ordered do too. We also want to know the quantity of each food/beverage ordered, its type, cost, name and ingredients. The ingredients that the item contains also have a name and type. The refreshments are categorized as dessert, drink, seafood and so on. These items are supplied by a company of which we want to know the business type as well as the code, name and address. These companies are located in a city.

A customer can book a seat at a cinema, restaurant and concert and each reservation has a duration, a type, a cost, a start date and time and is identified by the latter attribute along with the site in question.

These are all the places where the customers can host events. Due to the high costs of managing a wide array of locations, the company EventOrg decided to allow customers to book just 4 types of locations: cinema, restaurant, beach and the town hall. All these sites have an address, a capacity (maximum number of people that can be accommodated at once) and a name.

Since safety is a major concern for any respectable company, EventOrg makes sure that each site that can be booked is insured against all the more likely mishaps. Each site therefore has an insurance that is stipulated by an insurance company, which can be the same company that insures other sites but doesn't have to be.

To cut the expenses each site will feature an advertisement of a third party company. Each advertisement has a code, a duration for which the ad will be kept on our property, a start and end date along with the start and end times and a cost. Of the companies of which we show the ads we are interested to know the code, name and address. These companies are located in a city.

EventOrg provides customers the ability to choose if they want music to be played during the booked events and which kind (Reggae, Rock, Traditional Music, Hip Hop). The music, that has a code, a name and a type, is performed by a musician (an artist) identified by their art name of whom we also want to know their age and popularity.

In the case that customers decide to book seats at a cinema, we would like to know the film (identified by a code) name and genre (Comedy, Action Movie, Cartoon, SciFi Film). All films have a director and actors (who also have a role within the film).

As mentioned before, safety and standing for human rights is an enormous concern at EventOrg so they don't want to play media produced by crime convicts guilty of despicable acts. This is why to better judge the individual situations they want to know these people's code, which crime they were found guilty of committing, the severity of their involvement and when they were convicted. Based on these facts, if the company deems it appropriate, it will not play the media of these artists when guilty of particularly severe crimes.

We decided to split the general idea of an event from the actual event instance since this allows for better representation of the concepts we thought

about. The general event is identified by its type and it has a cost while the event instance is identified by its code and the general event of which it is an instance of. Clients can rate an event instance (which has a start date and time and an end date and time) on a particular date which has to be later than the date on which the event instance occurred. Organizers organize an event instance while the customers can book an event instance on a date. Event instances are hosted in one of the sites available.

To better promote EventOrg and its services, the company decided to put advertisements of the general events, the event instances and the locations available on various media channels. Each media channel can be differentiated from the others by looking at its type and its official name. For all the possible advertisements, the company is interested in keeping track of the code, the duration of the ad, the start date and time and the end date and time and finally the cost of displaying these messages on the specific platforms.

Satisfaction of Minimal Requirements

Point	Description
1	We have more than 12 main entities in the first version of the diagram
2	The first version of the diagram contains both IS-A relationships and generalizations
3	If the diagram is interpreted as a graph, it contains more than one cycle
4	The schema contains cardinality constraints of many different values on the participation of entities in relationships
5	The schema contains both optional and multi-valued attributes
6	There are more than 10 external constraints that cannot be represented in the ER model, present in the Constraints dictionary
7	There are tables of volumes for both the initial and restructured ER schemas, together with the explanations of their respective volumes
8	We have about 20 queries that are of interest in the domain chosen, each with an evaluation of its frequency, specified in the tables of accesses

8.I	Many of the queries contain aggregate operators and some contain more than one
8.II	Many of the queries are nested and some have 3 levels
8.III	More than half of the queries were written using views
8.IV	All queries involve at least two tables

1. Conceptual Design

Structured and Organized Requirements

- As for the clients, directors and organizers we identify them by their Social Security Number and we want to represent their first name, last name, email, age and sex. For organizers we are additionally interested in knowing their salary, license and hire date whereas for directors we are interested in just the salary and hire date.
- Sites have an address, composed of street name, civic number and zip code, a capacity (maximum number of people that can be accommodated at once), a name and an etype, indicating the category of the site (cinema, hall, beach, restaurant).
- For the city, it's identified by its name and the name of the county where it's located but we are also interested in the name of the region where the city is.
- For the media we are interested in its type and name (which also constitute its form of identification).
- For promotion codes we are interested in their start and expiration dates, the type, if they are used or not, their ID and their category.
- Artistes are identified by their art name and we also want to know their age, popularity and category.

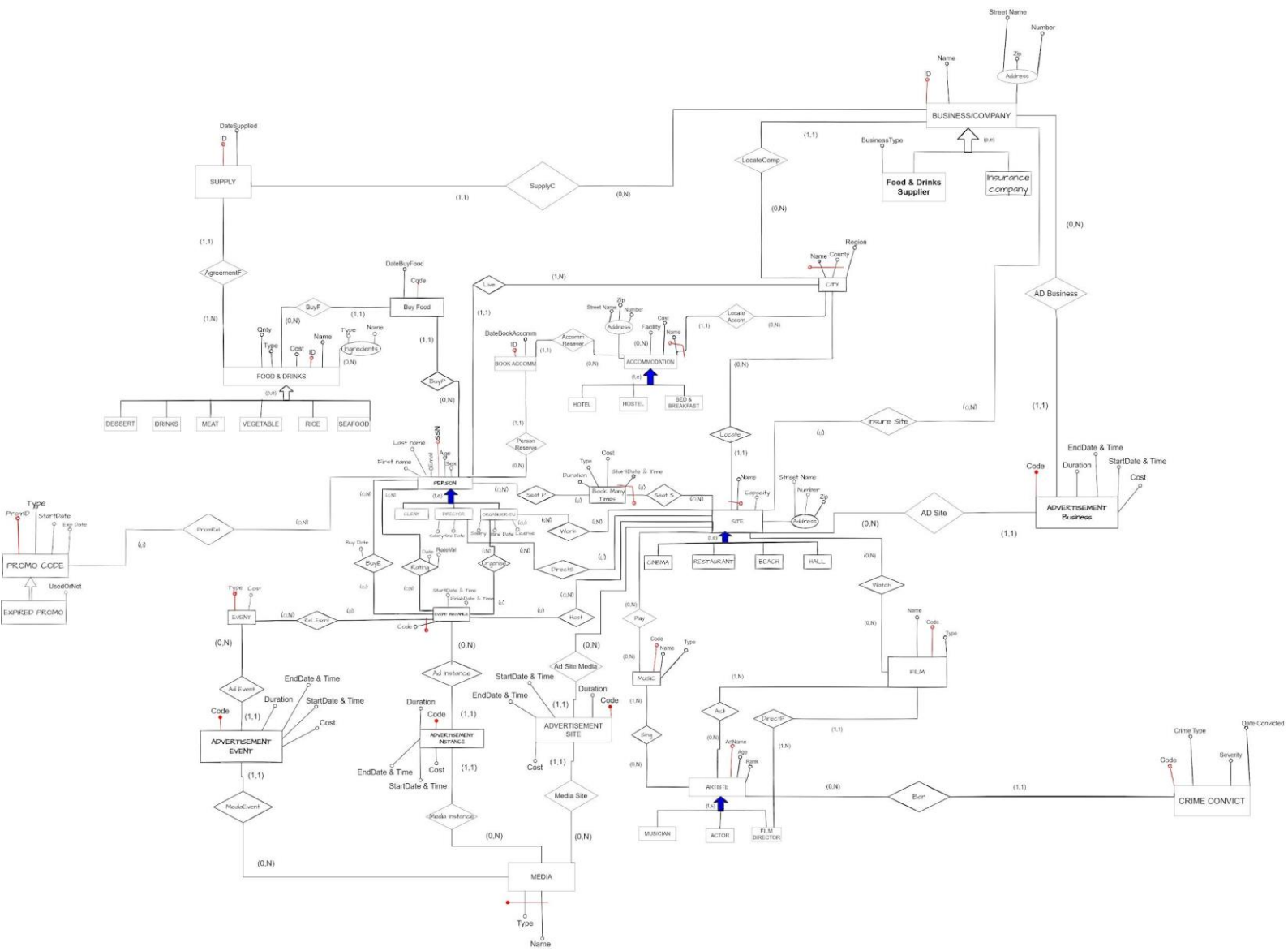
- For crime convicts, we are interested in their code, which crime they were found guilty of committing, the severity of their involvement and when they were convicted.
- Each order of food and drinks has a unique code and we also want to know the quantity of each food/beverage ordered, its type, cost, name and category.
- Each generic event is characterized by its type, but we also want to know its cost.
- For the specific event instances, we want to know their code, end date and time and start date and time.
- For businesses and companies we want to know the business type as well as the code, name, category and address (street name, civic number and zip code).
- For the music and films played we are interested in their code, name and type.
- The accommodation has an address (street name, civic number and zip code), a cost, a category and is identified by its name and the city where it is located.

Glossary of Terms

Term	Description	Synonym	Links
Client	The person who uses our product and books an event.	Customer, consumer	Site, Event, Organizer, City, Food and drinks, Accommodation
Director	The person who hires employees and governs a site assigned to him.	Administrator, supervisor	Site, City
Organizer	The person who	Coordinator	Site, Event, City

	micro organizes the event, making sure that everything is up to the company's standards.		
Site	The place where the booked event takes place.	Location, spot	Client, Event, Director, Organizer, City, Company, Media
Artiste	The person who performs (can be a musician/singer or an actor/director)	Creator, artist	Crime convict, Site
Crime Convict	The person whose music we want to decide whether to play it.	Criminal	Event, Artiste
Company	The organization that fulfills the task they set out to do, such as supply the refreshments or provide the insurance.	Association, organization	Site, Food and drinks, City
Media	The means of communication through which the advertisements are broadcast.	Means of mass communications	Event, Site
Event	The celebration that is booked by a client and that EventOrg organizes.	Celebration, ceremony	Site, Media, Client, Organizer
City	The place where accommodation and sites are located and people live.	Urban settlement	Company, Site, Client, Accommodation, Director, Client
Food and drinks	The refreshments that can be purchased at an event.	Refreshments	Client, Company
Accommodation	The place where clients can stay during an event.	Arrangement, housing	City, Client

Conceptual Schema Diagram



Data Dictionary for Conceptual Schema

Entity	Description	Attributes	Identifier
PERSON	Any human involved with the company	First name, last name, email, age, sex, SSN	SSN
CLIENT	The person who books an event		SSN
DIRECTOR	Governs a site assigned to him	Salary, hire date	SSN
ORGANIZER/DJ	The person tasked with organizing a particular event	Salary, hire date, license	SSN
FOOD & DRINKS	The refreshments present at the event	Quantity, type, cost, ID, name, ingredients (name, type)	ID
DESSERT	Type of food		ID
DRINKS	The beverages present in the food & drinks ordered		ID
MEAT	Type of food		ID
VEGETABLE	Type of food		ID
RICE	Type of food		ID
SEAFOOD	Type of food		ID
PROMO CODE	Code of the discount	PromID, type, start date, expiration date	PromID
EXPIRED PROMO	Expired code of the discount	Used or not	PromID
EVENT INSTANCE	Specific event as requested by the client	Code, finish date & time, start date & time	Code, EVENT
EVENT	Generic kind of celebration	type, cost	Type
ADVERTISEMENT EVENT	Advertisement for the generic event	Code, duration, end date & time, start date & time, cost	Code

ADVERTISEMENT INSTANCE	Advertisement for the specific event instance	Code, duration, end date & time, start date & time, cost	Code
ADVERTISEMENT SITE	Advertisement for a site	Code, duration, end date & time, start date & time, cost	Code
MEDIA	Means of communications through which the ads are shown	type, name	Type, Name
SITE	The location where an event takes place	name, capacity, address (street name, number, zip)	Name, CITY
CINEMA	A type of site. The attendees can watch films here.		Name, CITY
RESTAURANT	A type of site. The attendees can eat full meals here.		Name, CITY
BEACH	A type of site.		Name, CITY
HALL	A type of site.		Name, CITY
FILM	Type of entertainment present at cinemas	code, name, type	Code
ARTISTE	Any person who creates art	art name, age, rank	ArtName
MUSIC	Background sounds that are played during an event	code, name, type	Code
MUSICIAN	Person who plays the music		ArtName
ACTOR	Artist who performs in a film		ArtName
FILM DIRECTOR	Artist who oversees the production of the film		ArtName
CRIME CONVICT	Person who is found guilty of a crime	code, crime type, severity, date convicted	Code

BOOK MANY TIMES		duration, type, cost, start date & time	Start Date & time, SITE
ACCOMMODATION	Place where a person can stay for a while	name, cost, address (street name, number, zip), facility	Name, CITY
BOOK ACCOMM		ID, DateBookAccom	ID
HOTEL	Type of accommodation		Name, CITY
HOSTEL	Type of accommodation		Name, CITY
BED & BREAKFAST	Type of accommodation		Name, CITY
ADVERTISEMENT BUSINESS		Code, duration, end date & time, start date & time, cost	Code
BUY FOOD		code, Datebuyfood	Code
SUPPLY		ID, Datesupplied	ID
BUSINESS/COMPANY	Organization adept at their task	ID, name, address (street name, number, zip)	ID
FOOD & DRINKS SUPPLIER	Type of company that supplies food & drinks	Business type	ID
INSURANCE COMPANY	Type of company that provides insurances		ID
CITY	Large human settlement where many things can be located.	name, county, region	Name, County

Relationship	Description	Entities involved	Attributes
SEAT P	Associates people with one booking	Person (0, N) Book many times (1,1)	
WORK	Associates an	Organiser/Dj (1, N)	

	organiser with a place where they work	Site (1, N)	
DIRECTS	Associates a director with a site they oversee	Director (1, N) Site (1, 1)	
ORGANISE	Associates an organiser with an event instance they manage	Organiser/Dj (1, N) Event Instance (1, 1)	
RATING	Associates people with their respective event instances	Person (0, N) Event Instance (0, N)	Date, RateVal
BUYE	Associates the different people with an event instance	Person (0, N) Event Instance (0, 1)	Buy date
REL EVENT	Associates many events with just one event instance	Event (0, N) Event Instance (1, 1)	
AD EVENT	Associates events with advertisement event	Event (0, N) Advertisement event (1, 1)	
MEDIA EVENT	Associates an advertisement event with media channels	Advertisement event (1, 1) Media (0, N)	
MEDIA INSTANCE	Associates media channels with one advertisement instance	Media (0, N) Advertisement instance (1, 1)	
AD INSTANCE	Associates one advertisement instance with event instances	Event Instance (0, N) Advertisement instance (1, 1)	
MEDIA SITE	Associates one advertisement site with one media channels	Advertisement site (1, 1) Media (0, N)	
AD SITE MEDIA	Associates one advertisement site with various sites	Advertisement site (1, 1) Site (0, N)	
HOST	Associates one event instance with sites	Event Instance (1, 1) Site (0, N)	

SEAT S	Associates a booking with sites	Book many times (1,1) Site (0, N)	
WATCH	Associates cinemas with films	Cinema (0, N) Film (0, N)	
PLAY	Associates sites with types of music	Site (0, N) Music (0, N)	
SING	Associates types of music with artistes	Music (1, N) Artiste (0, N)	
ACT	Associates artistes with films	Artiste (0, N) Film (1, N)	
DIRECTF	Associates a film with film directors	Film (1, 1) Film director (1, N)	
BAN	Associates a crime convict with artistes	Crime convict (1, 1) Artiste (0, N)	
AD SITE	Associates an advertisement for a site with sites	Advertisement business (1,1) Site (0, N)	
INSURE SITE	Associates insurance companies with a site	Insure company (0, N) Site (1, 1)	
LOCATE	Associates a site with cities	Site (1, 1) City (0, N)	
AD BUSINESS	Associates business companies with an advertisement for a business	Business company (0, N) Advertisement business (1,1)	
LOCATECOMP	Associates a business/company with cities	Business/company (1, 1) City (0, N)	
LOCATE ACCOMM	Associates cities with an accommodation	City (0, N) Accommodation (1,1)	
ACCOMM RESERVE	Associates accommodation with a booking	Accommodation (0,N) Book accomm (1,1)	
PERSON RESERVE	Associates a booking with numerous people	Book accomm (1,1) Person (0,N)	
LIVE	Associates cities with a person	City (1,N) Person (1,1)	
BUYP	Associates people	Person (0,N)	

	with buying food	Buy Food (1,1)	
BUYF	Associates buying food with numerous foods or drinks	Buy Food (1,1) Food & drinks (0,N)	
AGREEMENTF	Associates foods and drinks with a supplier	Food & drinks (1,N) Supply (1,1)	
SUPPLYC	Associates a supplier with food and drinks suppliers	Supply (1,1) Food & drinks supplier (0, N)	
PROMREL	Associates people with a promotion code	Person (0,N) Promo code (1,1)	

Constraints Dictionary for Conceptual Schema

Constraints
<ol style="list-style-type: none"> 1. The expiration date cannot be earlier than the start date 2. A user cannot rate an event they didn't book or buy 3. A director cannot direct a site they haven't been assigned to 4. Each Site is directed by one Director. 5. Each film must be directed by one and only one film director. 6. An organizer cannot organize an event they haven't been tasked to organize 7. The number of reservations for a site cannot exceed the site capacity 8. The end date & time cannot be earlier than the start date & time 9. The cost, age, salary, duration, number of facilities, civic number in the address and capacity of a site cannot be negative numbers. 10. An Organiser/DJ cannot earn more than or equal to any of the Directors 11. Ratings and severity of crimes must be a percentage (0 -100)

12. If an Artiste is banned (severity > 75%), his musics and/or films must not be played on our sites
Derivations
<ol style="list-style-type: none"> 1. Site capacity can be derived by counting the maximum number of people which that space is designed to hold. 2. The number of sites in a city is obtained by counting all the different event locations that EventOrg owns in that city.

Table of Volumes for Conceptual Schema

Concept	Type	Volume
Person	E	10,000
Client	E	9,940
Director	E	10
Organiser/DJ	E	50
Food & Drinks	E	4,000
Dessert	E	500
Drinks	E	500
Meat	E	500
Vegetable	E	500
Rice	E	500
Seafood	E	500
Promo code	E	500
Expired code	E	300
Event instance	E	100
Event	E	5
Advertisement-event	E	10

Advertisement-instance	E	50
Advertisement-site	E	10
Media	E	10
Site	E	50
Cinema	E	20
Restaurant	E	10
Beach	E	10
Hall	E	10
Film	E	400
Artiste	E	4,000
Music	E	500
Musician	E	800
Actor	E	3,000
Film Director	E	200
Crime convict	E	1,000
Book many times	E	5,000
Accommodation	E	40
Book accom	E	1,000
Hotel	E	20
Hostel	E	10
Bed & Breakfast	E	10
Advertisement Business	E	250
Buy Food	E	15,000
Supply	E	5,000
Business/Company	E	100
Food & Drinks Supplier	E	60
Insurance	E	20
City	E	20
Ban	R	1,000

DirectF	R	400
Act	R	20,000
Sing	R	80,000
Play	R	5,000
Watch	R	800
Ad_Event	R	10
MediaEvent	R	10

Ad Instance	R	50
Media Instance	R	50
Ad Site Media	R	10
Media Site	R	10
Rel Event	R	100
Host	R	100
BuyE	R	70
Rating	R	19,880
Organise	R	100
PromRel	R	500
DirectS	R	50
Work	R	200
Seat P	R	5,000
Seat S	R	5,000
Person Reserve	R	1,000
Accomm Reserve	R	1,000
Live	R	10,000
Locate Accom	R	40
Locate	R	50

Insure Site	R	50
AD Site	R	250
AD Business	R	250
BuyP	R	15,000
BuyF	R	15,000
AgreementF	R	5,000
SupplyC	R	5,000
LocateComp	R	100

Explanation Of Table Of Volumes For Relationships

For simplicity, all types including crime types, media types, business types, etc, occur the same number of times with respect to their entities.

1. The number of occurrences of the [Ban](#) relationship is equal to the number of CRIME CONVICT, since the cardinalities dictate that each CRIME CONVICT is committed by one and only one ARTISTE.
2. The number of occurrences of the [DirectF](#) relationship is equal to the number of FILMs, since the cardinalities dictate that each FILM is directed by one and only one FILM_DIRECTOR (there a director directs on average 2 films).
3. If an ARTISTE acts on average 5 FILMs, we have $4,000 \times 5 = 20,000$ occurrences for the relationship [Act](#) (and thus $20,000 \div 400 = 50$ ARTISTEs on average for each FILM).
4. If an ARTISTE sings on average 20 MUSICs, we have $4,000 \times 20 = 80,000$ occurrences for the relationship [Sing](#) (and thus $80,000 \div 500 = 160$ ARTISTEs on average for each Music).
5. If a MUSIC is played on average 10 times on a SITE, we have $500 \times 10 = 5,000$ occurrences for the relationship [Play](#) (and thus $5,000 \div (50-20) = 167$ MUSICs on average for each SITE excluding CINEMAs(20)).

6. If a FILM is watched on average 2 times on a SITE(only in CINEMA) per week, we have $400 \times 2 = 800$ occurrences for the relationship [Watch](#).
7. The number of occurrences of the [Ad_Event](#) relationship is equal to the number of ADVERTISEMENT_EVENT, deduced from the cardinalities of ADVERTISEMENT_EVENT.
8. The number of occurrences of the [MediaEvent](#) relationship is equal to the number of ADVERTISEMENT_EVENT, deduced from the cardinalities of ADVERTISEMENT_EVENT.
9. The number of occurrences of the [Ad_Instance](#) relationship is equal to the number of ADVERTISEMENT_INSTANCE, deduced from the cardinalities of ADVERTISEMENT_INSTANCE.
10. The number of occurrences of the [Media_Instance](#) relationship is equal to the number of ADVERTISEMENT_INSTANCE, deduced from the cardinalities of ADVERTISEMENT_INSTANCE.
11. The number of occurrences of the [Ad Site Media](#) relationship is equal to the number of ADVERTISEMENT_SITE, deduced from the cardinalities of ADVERTISEMENT_SITE.
12. The number of occurrences of the [Media_Site](#) relationship is equal to the number of ADVERTISEMENT_SITE, deduced from the cardinalities of ADVERTISEMENT_SITE.
13. The number of occurrences of the [Rel_Event](#) relationship is equal to the number of EVENT_INSTANCE, since the cardinalities dictate that each EVENT_INSTANCE is an instance of one and only one EVENT type.
14. The number of occurrences of the [Host](#) relationship is equal to the number of EVENT_INSTANCE, deduced from the cardinalities of EVENT_INSTANCE.
15. The number of occurrences of the [BuyE](#) relationship is less than the number of EVENT_INSTANCE, deduced from the cardinality. So let the number of occurrences of the BuyE relationship be [70](#).
16. If a CLIENT rates on average 2 EVENT INSTANCES per week, we have $9,940 \times 2 = 19,880$ occurrences for the relationship [Rating](#) (and thus $19,880 \div 100 = 199$ Ratings on average for each EVENT INSTANCE).
17. If an ORGANISER/DJ organises on average 2 EVENT INSTANCES per week, we have $50 \times 2 = 100$ occurrences for the relationship Organise. The [organise](#) relationship must be equal to the number of event instances because of (1,1), but also it has to be at least the number of Organisers/DJs because of (1,N).
18. The number of occurrences of the [PromRel](#) relationship is equal to the number of PROMO CODE, deduced from the cardinality of the PROMO CODE.

19. The number of occurrences of the [DirectS](#) relationship is equal to the number of SITE, deduced from the cardinality of the SITE. But this part is tricky because the cardinality between the DirectS relationship and the DIRECTOR entity is (1,N), which means that the SITE entity cannot be less than the number of DIRECTORs.
20. If an ORGANISER/DJ works on average in 4 different SITES, we have $50 \times 4 = 200$ occurrences for the relationship [Work](#).
21. The number of occurrences of the [Seat P](#) relationship is equal to the number of BOOK MANY TIMES = 5,000 per week.
22. The number of occurrences of the [Seat S](#) relationship is equal to the number of BOOK MANY TIMES=5,000 per week.
23. The number of occurrences of the [Person Reserve](#) relationship is equal to the number of BOOK ACCOMM = 1,000.
24. The number of occurrences of the [Accomm Reserve](#) relationship is equal to the number of BOOK ACCOMM = 1,000.
25. The number of occurrences of the [Live](#) relationship is equal to the number of PERSON = 10,000 per week.
26. The number of occurrences of the [Locate Accom](#) relationship is equal to the number of ACCOMODATION = 40.
27. The number of occurrences of the [Locate](#) relationship is equal to the number of SITE = 50.
28. The number of occurrences of the [Insure Site](#) relationship is equal to the number of SITE = 50.
29. The number of occurrences of the [AD Site](#) relationship is equal to the number of ADVERTISEMENT BUSINESS = 250.
30. The number of occurrences of the [AD Business](#) relationship is equal to the number of ADVERTISEMENT BUSINESS = 250.
31. The number of occurrences of the [BuyP](#) relationship is equal to the number of BUY FOOD = 15,000.
32. The number of occurrences of the [BuyF](#) relationship is equal to the number of BUY FOOD = 15,000.
33. The number of occurrences of the [AgreementF](#) relationship is equal to the number of SUPPLY = 5,000. But this part is tricky because the cardinality between the AgreementF relationship and the Food & Drinks entity is (1,N), which means that the Supply entity cannot be less than the number of food & drinks.
34. The number of occurrences of the [SupplyC](#) relationship is equal to the number of SUPPLY = 5,000.

35. The number of occurrences of the [LocateComp](#) relationship is equal to the number of Business/Company = 100.

Operations

01. Find the cost, type and code of the event instance that was rated the best (above 75% ratings) by most of our clients.
02. Find the ArtNames and Ranks of all artistes that play music genre Rock and were banned for having committed a hate speech crime (note: banned if the severity is 76-100%).
03. Which EVENT type is advertised most (birthday, picnic, etc) to MEDIA type t.
04. Total cost spent on each media channel's ads (so how much for billboards? How much for newspaper? How much for TV ads? How much for Radio ads?).
05. SSNs and Names of Organisers/DJs who organise an EVENT in a site s
06. ArtNames, Ages and Ranks of Musicians whose musics were not banned even though they are/were crime convicts, but the severity is not grave enough for their musics to be banned.
07. ArtNames and Ages of Film Directors who are in the top 25% rank, act in their own directed movies and have never been a crime convict.
08. Clients (Name and SSN) who had been given promo codes but failed to use them (expired or decided not to).
09. Which SITE generates more money in terms of AD from companies and in which CITY/Location is the site
10. Which accommodation is the most booked among our clients and in which Region is it located?
11. Find food IDs and their suppliers BusinessTypes and names and also the date supplied (a food can be supplied by more than one supplier).
12. Find clients (SSN and Name) that buy event instances in a site which is not in the same city they live
13. Find clients (Name and SSN) who booked accommodation in a city which is different from the city in which the site they booked their seats is located.
14. Which ARTISTE within the top 25% has had his music played in our SITE less than any other singer not in the top 25% (collaboration between musicians is allowed).

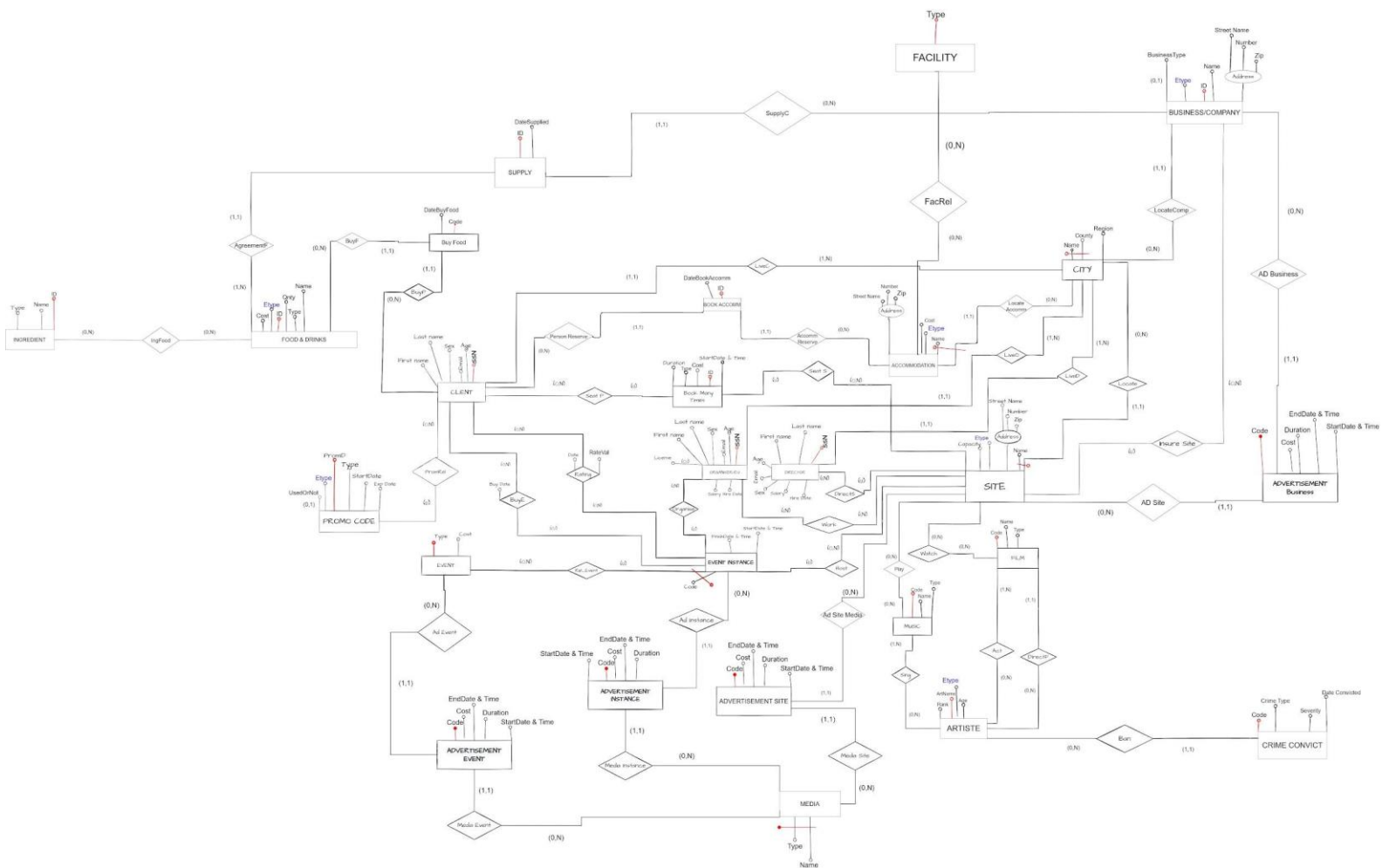
15. Find MUSICs that have their singers convicted (not necessarily banned) together with the crime type, severity and date convicted.
16. Get the names, locations and regions of the companies at which our sites are insured.
17. Names of artistes who act in a Film type comedy and also sing Music type Reggae.
18. Add a new client who bought a food type Biryani Rice with 2 ingredients (appetiser and coloriser).
19. Assign a new promo code to an existing client.

Table of Operations			
OPERATION	TYPE		FREQUENCY
Operation 1	Batch		3 Per week
Operation 2	Interactive		1 Per week
Operation 3	Batch		1 Per week
Operation 4	Batch		1 Per week
Operation 5	Batch		3 Per week
Operation 6	Batch		1 Per week
Operation 7	Batch		1 Per week
Operation 8	Batch		2 Per week
Operation 9	Batch		5 Per week
Operation 10	Batch		1 Per week
Operation 11	Batch		10 Per week
Operation 12	Batch		2 Per week
Operation 13	Batch		2 Per week
Operation 14	Batch		5 Per week
Operation 15	Batch		2 Per week
Operation 16	Batch		1 per week

Operation 17	Interactive		6 per week
Operation 18	Interactive		500 per week
Operation 19	Interactive		500 per week

2. Restructuring of the Conceptual Scheme

Restructured Schema Diagram



Data Dictionary for Restructured Schema

Entity	Description	Attributes	Identifier
CLIENT	The person who books an event	First name, last name, email, age, sex, SSN	SSN
DIRECTOR	Governs a site assigned to him	Salary, hire date, first name, last name, email, age, sex, SSN	SSN
ORGANIZER/DJ	The person tasked with organizing a particular event	Salary, hire date, license, first name, last name, email, age, sex, SSN	SSN
FOOD & DRINKS	The refreshments present at the event	Quantity, type, cost, ID, name, etype	ID
PROMO CODE	Code of the discount	PromID, type, start date, ExpDate, etype, UsedOrNot	PromID
EVENT INSTANCE	Specific event as requested by the client	Code, finish date & time, start date & time	Code, EVENT
EVENT	Generic kind of celebration	type, cost	Type
ADVERTISEMENT EVENT	Advertisement for the generic event	Code, duration, end date & time, start date & time, cost	Code
ADVERTISEMENT INSTANCE	Advertisement for the specific event instance	Code, duration, end date & time, start date & time, cost	Code
ADVERTISEMENT SITE	Advertisement for a site	Code, duration, end date & time, start date & time, cost	Code
MEDIA	Means of communications through which the ads are shown	type, name	Type, Name
SITE	The location where an event takes place	name, capacity, address (street name, number, zip), etype	Name, CITY

FILM	Type of entertainment present at cinemas	code, name, type	Code
ARTISTE	Any person who creates art	art name, age, rank, etype	ArtName
MUSIC	Background sounds that are played during an event	code, name, type	Code
CRIME CONVICT	Person who is found guilty of a crime	code, crime type, severity, date convicted	Code
BOOK MANY TIMES	Multiple booking	duration, type, cost, start date & time	Start Date & time, SITE
ACCOMMODATION	Place where a person can stay for a while	name, cost, address (street name, number, zip), etype, facility	Name, CITY
BOOK ACCOMM	Booking for an accommodation	ID, DateBookAccom	ID
ADVERTISEMENT BUSINESS	Advertisement for a business or company	Code, duration, end date & time, start date & time, cost	Code
BUY FOOD	Purchase of food or drinks	code, Datebuyfood	Code
SUPPLY	Supply of food and beverages	ID, Datesupplied	ID
BUSINESS/COMPANY	Organization adept at their task	ID, name, address (street name, number, zip), etype, business type	ID
CITY	Large human settlement where many things can be located.	name, county, region	Name, County
INGREDIENT	The components of foods and beverages.	ID, Type, Name	ID
FACILITY	The amenities provided by an accommodation	Type	Type

Relationship	Description	Entities involved	Attributes
SEAT P	Associates clients with one booking, which can be of several seats	Client (0, N) Book many times (1,1)	
WORK	Associates an organiser with a place where they work	Organiser/Dj (1, N) Site (1, N)	
DIRECTS	Associates a director with a site they oversee	Director (1, N) Site (1, 1)	
ORGANISE	Associates an organiser with an event instance they manage	Organiser/Dj (1, N) Event Instance (1, 1)	
RATING	Associates clients with their respective event instances	Client (0, N) Event Instance (0, N)	Date, RateVal
BUYE	Associates the different clients with an event instance	Client (0, N) Event Instance (0, 1)	Buy date
REL EVENT	Associates many events with just one event instance	Event (0, N) Event Instance (1, 1)	
AD EVENT	Associates events with advertisement event	Event (0, N) Advertisement event (1, 1)	
MEDIA EVENT	Associates an advertisement event with media channels	Advertisement event (1, 1) Media (0, N)	
MEDIA INSTANCE	Associates one media channel with one advertisement instance	Media (0, 1) Advertisement instance (1, 1)	
AD INSTANCE	Associates one advertisement instance with event instances	Event Instance (0, N) Advertisement instance (1, 1)	

MEDIA SITE	Associates one advertisement site with one media channels	Advertisement site (1, 1) Media (0, N)	
AD SITE MEDIA	Associates one advertisement site with various sites	Advertisement site (1, 1) Site (0, N)	
HOST	Associates one event instance with sites	Event Instance (1, 1) Site (0, N)	
SEAT S	Associates a booking with sites	Book many times (1,1) Site (0, N)	
WATCH	Associates cinemas with films	Cinema (0, N) Film (0, N)	
PLAY	Associates sites with types of music	Site (0, N) Music (0, N)	
SING	Associates types of music with artistes	Music (1, N) Artiste (0, N)	
ACT	Associates artistes with films	Artiste (0, N) Film (1, N)	
DIRECTF	Associates a film with film directors	Film (1, 1) Film director (1, N)	
BAN	Associates a crime convict with artistes	Crime convict (1, 1) Artiste (0, N)	
AD SITE	Associates an advertisement for a site with sites	Advertisement business (1,1) Site (0, N)	
INSURE SITE	Associates insurance companies with a site	Insure company (0, N) Site (1, 1)	
LOCATE	Associates a site with cities	Site (1, 1) City (0, N)	
AD BUSINESS	Associates business companies with an advertisement for a business	Business/company (0, N) Advertisement business (1,1)	
LOCATECOMP	Associates a business/company with cities	Business/company (1, 1) City (0, N)	
LOCATE ACCOMM	Associates cities with an accommodation	City (0, N) Accommodation (1,1)	

ACCOMM RESERVE	Associates accommodation with a booking	Accommodation (0,N) Book accomm (1,1)	
CLIENT RESERVE	Associates a booking with numerous clients	Book accomm (1,1) Client (0,N)	
LIVEC	Associates cities with a client	City (1,N) Client (1,1)	
LIVEO	Associates cities with an organizer	City (1,N) Organizer/DJ (1,1)	
LIVED	Associates cities with a director	City (1,N) Director (1,1)	
BUYP	Associates clients with buying food	Client (0,N) Buy Food (1,1)	
BUYF	Associates buying food with numerous foods or drinks	Buy Food (1,1) Food & drinks (0,N)	
AGREEMENTF	Associates foods and drinks with a supplier	Food & drinks (1,N) Supply (1,1)	
SUPPLYC	Associates a supplier with food and drinks suppliers	Supply (1,1) Food & drinks supplier (0, N)	
PROMREL	Associates clients with a promotion code	Client (0,N) Promo code (1,1)	
INGFOOD	Associates ingredients with foods and beverages that are made with them	Ingredient (0, N) Food & drinks (0, N)	
FACREL	Associates facilities with the accommodation where they are situated	Facility (0, N) Accommodation (0, N)	

Constraints Dictionary for Restructured Schema

Constraints

1. The expiration date cannot be earlier than the start date
2. A user cannot rate an event they didn't book or buy
3. A director cannot direct a site they haven't been assigned to
4. Each Site is directed by one Director.
5. Each film must be directed by one and only one film director.
6. An organizer cannot organize an event they haven't been tasked to organize
7. The number of reservations for a site cannot exceed the site capacity
8. The end date & time cannot be earlier than the start date & time
9. The cost, age, salary, duration, number of facilities, civic number in the address and capacity of a site cannot be negative numbers.
10. An Organiser/DJ cannot earn more than or equal to any of the Directors
11. Ratings and severity of crimes must be a percentage (0 -100)
12. If an Artiste is banned (severity > 75%), his musics and/or films must not be played on our sites

Derivations

1. Site capacity can be derived by counting the maximum number of people which that space is designed to hold.
2. The number of sites in a city is obtained by counting all the different event locations that EventOrg owns in that city.

Restructuring of the E-R schema

We restructure our er schema based on the following:

1). Analysis of redundancies in our schema:

A redundancy in a conceptual schema corresponds to a piece of information that can be derived (that is, obtained by a series of retrieval operations) from other data.

In our case, we do not have a single redundant data as can be seen from the ER schema.

2). REMOVING GENERALIZATIONS

In removing GENERALIZATIONS, we consider the advantages and disadvantages of each of the possible choices in terms of storage needed and the cost of the operations involved.

We can, however, establish some general rules.

- Option 1, [Merging the children entities into parent](#) - is convenient when the operations involve the occurrences and the attributes of the parent and the children entities more or less in the same way. In this case, even if we waste storage for the presence of null values, the choice assures fewer accesses compared to the others in which the occurrences and the attributes are distributed among the various entities.
- Option 2, [Merging the parent entity into the children entities](#) - is possible only if the generalization is total, otherwise the occurrences of the parent that are occurrences of none of the children would not be represented. It is useful when there are operations that refer only to occurrences of child1, child2,...,or childn and so they make distinctions between these entities. In this case, storage is saved compared to Option 1, because, in principle, the attributes never assume null values. Further, there is a reduction of accesses compared to Option 3, because it is not necessary to visit the parent in order to access some attributes of child1 and child2.
- Option 3, [Substitution of the generalization with relationships](#) - is useful when the generalization is not total and the operations refer to either occurrences and attributes of the children or of the parent, and therefore make distinctions between child and parent entities. In this case, we can save storage compared to Option 1 because of the absence of null values, but there is an increase in the number of accesses to keep the occurrences consistent.

So the above guides how we remove generalizations. We prioritise less number of accesses where appropriate.

01. For the ARTISTE entity and its subentities, we can use either option1 or option2 to remove the generalisation because it's total.

- a. Storage: Both option 1 and 2 have the same amount of storage used because there's no sub entity that has a dedicated attribute which may result in more null values when option 1 is used.
- b. Number of Access:
 - i. For option 1 operation 2, we need $500/4 = 125$ accesses to the Music entity to read the type R&B, $80,000/4 = 20,000$ reads to read the data in the sing relationship (because we said that on average, an artiste sings 20 songs for a total of 4,000 artistes, and the 4 is there for 4 different types), followed by another $4,000/4 = 1,000$ read accesses to the Artiste entity ($\frac{1}{4}$ of the artistes sing each type), followed by $1,000/4 = 250$ for the ban relationship, and lastly $1,000/4 = 250$ read accesses for the crime convict entity (notice that the 1,000 is the maximum that CAN be banned, not necessarily banned unless the severity is between 76-100%). In total, we CAN have $125 + 20,000 + 1,000 + 250 + 250 = 21,625$ maximum accesses for operation 2 option 1. But we know that option 1 always uses at most the same number of accesses as that of option 2 or 3. So any other option cannot be better than option 1 in this regard. Moreover, some of the operations(2 and 17) do not make any distinctions between the sub entities as explained in option 2. So option 1 is the better choice.

02. For the SITE entity and its subentities, we can use either option1 or option 2 to remove the generalisation because it's also total. Here, both options use the same amount of storage. But we know that option 1 always uses at most the same number of accesses as that of option 2 or 3. So any of the other 2 options cannot be better than option 1 in terms of access. Therefore, we merge the subentities into the parent entity.

03. For the BUSINESS/COMPANY entity and its subentities, we can use either option1 or option 3 to remove the generalisation because it's NOT total.

- a. Storage:
 - i. Option 1 uses more in terms of storage because of the BusinessType attribute of the sub entity Food & Drinks Supplier. If the BusinessType

attribute uses 4 bytes, then we use $(100-30)*4 = 280$ bytes more in terms of storage.

- ii. Option 3 does not have null values in this case and is memory efficient with respect to option 1.

b. Access:

- i. For Option 1 operation 11, we need 5,000 accesses to the AgreementF relationship, 5,000 accesses to the Supply entity, 5,000 accesses to SupplyC relationship and finally 60 accesses to the Business/Company entity that supplies Food & Drinks, a total of $5,000 + 5,000 + 5,000 + 60 = 15,060$ accesses. Since this operation occurs 10 times, we have 150,600
- ii. For Option 3, we need additional relationships between the parent and the sub entities. Now considering operation 11, we have the same number of accesses as in i) plus additional 60 accesses to the relationship between the parent and the Food & Drinks Supplier and ,yet still, another 60 additional accesses to the Food & Drinks Supplier entity for the BusinessType attribute. So a total of $150,600 + (60+60)*10 = 151,800$ accesses.
- iii. Given these analysis, we therefore use option 1 based on the number of access difference (the storage difference is just a mere 280 bytes though)

04. For the ACCOMODATION entity and its subentities, we can use either option1 or option 2 to remove the generalisation because it's total.

- a. Storage: Both option 1 and 2 have the same amount of storage used because there's no sub entity that has a dedicated attribute which may result in more null values when option 1 is used.
- b. Access: We know that option 1 always uses at most the same number of accesses as that of option 2 or 3. So any other option cannot be better than option 1 in terms of access. Moreover, some of the operations do not make any distinctions between the sub entities as explained in option 2. So option 1 is the better choice.

05. For the PERSON entity and its subentities, we can use either option1 or option 2 to remove the generalisation because it's total.

- a. Storage:
 - i. Option 1 uses more in terms of storage. For example, if we consider the attributes Salary, HireDate and License to have 4 bytes each, then for only the Client sub entity, we have $(4+4+4)*9,940 = 119,280$, which

is 119 kbytes (for having null values for the attributes salary, hire date and license). Also for the Director sub entity, we have $4 \times 10 = 40$ because we don't store license information of directors. So a total of $119,280 + 40 = 119,320 = 119$ kbytes more wasted (29,830 null values).

- ii. Option 2 may have null values for the License attribute, but so does option 1 too, which we did not count. Therefore, option 1 uses 119 kbytes more than option 2.
- b. Access: Option 2 is useful when there are operations that refer only to occurrences of child1, child2,...,or childn and so they make distinctions between these entities. In this case, storage is saved compared to Option 1. And in our case, all the operations make clear distinction between the sub entities of the PERSON. Also, using operations, option 2 has the same number of accesses as option 1, which we shall write clearly in the table of accesses section. Therefore, we use option 2 in this regard.

06. For the FOOD & DRINKS entity and its subentities, we can use either option1 or option 3 to remove the generalisation because it's NOT total.

- a. In terms of storage, both option 1 and 2 use the same amount of storage as can be seen from the schema.
- b. In terms of accesses, option 1 always has a lesser number of accesses compared to option 3. From this, we choose option 1.

07. Elimination of IS-A:.

- a. Storage: If we assume that the attribute UsedOrNot uses 4 bytes, then option 1 will have $4 \times (500 - 300) = 800$ bytes wasted (200 null values).
- b. Access:
 - i. Using Option 1, operation 8. If we assume that 20% of the expired promos were not used (that is 60), then we have 60 accesses to the Promo Code entity, followed by another 60 to the PromRel relationship. There can be a maximum of 60 clients if the promos that are/were not used belong to distinct clients. So we have in total $(60 \times 3) \times 2 = 360$ because operation 8 occurs twice.
 - ii. Using Option 3, operation 8. Here, we have the same number of accesses as that of option 1, except that we will have additional 60 accesses to the relationship between the Promo Code and the Expired Promo, and another 60 to the Expired Promo - a total of $360 + (60 + 60) \times 2 = 600$; 240 more in terms of access. So we, therefore, choose option 1.

3). **Partitioning and merging of entities and relationships** decides whether it is convenient to partition concepts in the schema into more than one concept or to merge several separate concepts into a single one.

- a. It is tempting to merge the Organiser/DJ entity with the Director entity, but based on the following reasons, we decided not to merge them.
 - The license attribute applies to only the Organiser/DJ entity. So merging the two, would present null values for the Director's records
 - All the operations make a clear distinction between the two entities, which is one of the reasons to use option 2.
 - Lastly, the tables (of the relationships and the entity itself) will be larger if we merge the two. In terms of retrieval, smaller tables are preferable because we can retrieve large amounts of needed records at once.
 - The live relationship is exactly the same, but we will handle that in the restructuring of the relational schema.
- b. We may want to merge the DirectF relationship into the Act relationship, but as we can see in the schema, if we merge them, then a film director would not be able to direct a film he acts (because the relationship would be identified by the artname and the film code), which is wrong and not part of the specification.

Table of Volumes for Restructured Schema

Concept	Type	Volume
Client	E	9,940
Director	E	10
Organiser/DJ	E	50
Food & Drinks	E	4,000
Ingredient	E	20
Promo code	E	500
Event instance	E	100
Event	E	5
Advertisement Event	E	10
Advertisement Instance	E	50
Advertisement Site	E	10
Media	E	10
Site	E	50
Film	E	400
Artiste	E	4,000
Music	E	500
Crime convict	E	1,000
Book many times	E	5,000
Accommodation	E	40
Facility	E	3
Book accom	E	1,000
Advertisement Business	E	250
Buy Food	E	15,000
Supply	E	5,000
Business/Company	E	100
City	E	20

Ban	R	1,000
DirectF	R	400
Act	R	20,000
Sing	R	80,000
Play	R	5,000
Watch	R	200
Ad_Event	R	10

Ad Instance	R	50
Ad Site Media	R	10
Media Event	R	10
Media Instance	R	70
Media Site	R	10
Rel Event	R	100
Host	R	100
BuyE	R	70
Rating	R	19,880
Organise	R	100
PromRel	R	500
DirectS	R	50
Work	R	200
Seat P	R	5,000
Seat S	R	5,000
Person Reserve	R	1,000
Accomm Reserve	R	1,000
LiveC	R	9,940
LiveO	R	50
LiveD	R	10

Locate Accom	R	40
Locate	R	50
Insure Site	R	50
AD Site	R	250
AD Business	R	250
BuyP	R	15,000
BuyF	R	15,000
AgreementF	R	5,000
SupplyC	R	5,000
LocateComp	R	100
IngFood	R	6,000
FacRel	R	40

Explanation Of Table Of Accesses

1. We need to access the Rating relationship to read every rated event. This occurs for a maximum of 19,880 times because we had said that every client rates on average 2 event instances. From the Rating relationship, we already get the code and type of the event instance, with which we can access the Event entity for 4 times (because there are 4 types) without going through either the event instance or the Rel_Event. Since operation 1 occurs 3 times, we have a total access of $(19,880 + 4) * 3 = 59,652$ times.
2. We need $500/4 = 125$ accesses to the Music entity to read the type Rock, $80,000/4 = 20,000$ reads to read the data in the sing relationship (because there are 4 different types and each type is sung $\frac{1}{4}$ times), followed by another $4,000/4 = 1,000$ read accesses to the Artiste entity (because on average $\frac{1}{4}$ sings each type), then $1,000/4 = 250$ for the ban relationship, and lastly $1,000/4 = 250$ read accesses for the crime convict entity (notice that the 1,000 is the maximum that CAN be banned, not necessarily banned unless the severity is between 76-100%). In total, we CAN have $125 + 20,000 + 1,000 + 250 + 250 = 21,625$ maximum accesses
3. Here, we don't need to access any entity because we can get all the required information from the 2 relationships Ad Event and Media Event. We need 10 accesses to the Ad Event relationship. But since each media type advertises $\frac{1}{4}$ of the events, we have $10/4 = 3$ for the relationship MediaRel (for a particular media type). So a total of $10 + 3 = 13$ accesses.
4. Here, we need 10 accesses to the entity Advertisement Event, 10 to the relationship Media Event, 50 to the entity Advertisement Instance, 50 to the relationship Media Instance, 10 to the entity Advertisement Site, 10 to the relationship Media Site. So a total of $10*4 + 50*2 = 140$ accesses.
5. We need $100/50 = 2$ accesses to the relationship Host for a particular site(because each site hosts on average 2 event instances), then we have 4 accesses to the entity Organise/DJ because we assume that each site has on average 4 Organisers/DJs, followed by another $4*4$ accesses to the relationship Organise because each Organiser/DJ organises on average 4 event instances per week - a total of $(2 + 4 + 16)*3 = 66$ accesses(operation 5 occurs 3 times).
6. If we assume that no artiste was banned because the severity of the crime is not grave enough (severity $\leq 75\%$), we have 1,000 accesses to both the entity Crime Convict and the relationship Ban. Also a maximum of 1,000 artistes can be convicted if the crimes are committed by distinct artistes. So we have a maximum total of $1,000*3 = 3,000$.

7. If 20 of the directors have been convicted, then 180 are not convicted - so 20 accesses to the Ban relationship and 180 to the Artiste entity. We need $5 \times 180 = 900$ accesses to the relationship Act because we said that an artiste acts on average 5 films. Then lastly, we have $180 \times 2 = 360$ accesses to the relationship DirectF because we said that each director directs on average 2 films. We therefore have $20 + 180 + 900 + 360 = 1,460$.
8. If we assume that 20% of the expired promos were not used (that is 60), then we have 60 accesses to the Promo Code entity, followed by another 60 to the PromRel relationship. There can be a maximum of 60 clients if the promos that are not used belong to distinct clients. So we have in total $(60 \times 3) \times 2 = 360$ (operation 8 occurs twice).
9. We need 250 accesses to the relationship Ad Site and another 250 for the entity Advertisement Business. So we have $(250 + 250) \times 5 = 2,500$ accesses because operation 9 occurs 5 times.
10. We need 1,000 accesses to the relationship Accom Reserve, then 40 accesses to the relationship Locate Accom and lastly we have 20 accesses to the entity City. So we have a total of $1,000 + 40 + 20 = 1,060$ accesses.
11. We have 5,000 accesses to the AgreementF relationship, 5,000 accesses to the SupplyC relationship, 5,000 accesses to the Supply entity and finally 60 accesses to the Business/Company entity - a total of $(5,000 \times 3 + 60) \times 10 = 150,600$ for occurring 10 times.
12. We need 70 accesses to BuyE, then in which city those events were organised (70 for the Host relationship), then the names and SSN of those clients (70 for the Client entity if all the clients are distinct), and finally where they live (70 for the LiveC relationship). So we have a total of $(70 \times 4) \times 2 = 560$ accesses (the operation occurs twice).
13. We have 1,000 read accesses to the Person Reverse relationship, 1,000 to the Accom Reserve relationship, 1,000 to read the details of those 1,000 clients if they are all distinct, 5,000 accesses to the relationship SeatP for those 1,000 distinct clients (because a client can book many seats where one of which is different from the city he lives) and lastly, another 5,000 read accesses to the relationship SeatS. So we have a total of $(1,000 \times 3 + 5,000 \times 2) \times 2 = 13,000$ accesses (we have 2 occurrences of this operation).
14. 5,000 accesses to the play relationship, 80,000 access to the sing relationship and lastly, we have 4,000 accesses to the artiste entity because we said that on average an artiste sings 20 musics (including collaborations). So we have a total of $(5,000 + 80,000 + 4,000) \times 5 = 445,000$ (the operation repeats for 5 times).

15. We have 1,000 accesses to the Ban relationship, 1,000 for Crime Convict entity and $1,000 \times 20 = 20,000$ for the sing relationship because on average an artiste sings 20 songs (assuming that all the 1,000 are different artistes). So we have $(1,000 + 1,000 + 20,000) \times 2 = 44,000$ (This operation occurs twice).
16. We have 50 for the relationship Insure Site, 20 for the insurance companies, 20 for the relationship LocateComp, and 20 to the City entity to get the regions. So we have a total of $50 + 20 + 20 + 20 = 110$
17. We have 500 musics ($500/4 = 125$ for each music type), $80,000/4 = 20,000$ instances of the sing relationship, $400/4 = 100$ for each film type, and lastly $20,000/4 = 5,000$ for the Act relationship. A total of $(125 + 20,000 + 100 + 5,000) \times 6 = 151,350$ because the operation repeats 6 times.
18. We have 1 write access to the Client entity, BuyP relationship, Buy Food entity and BuyF relationship. Then we have 1 read access to the Food & Drinks entity, 2 read access to the Ingredient entity and 2 write access to the IngFood relationship. If write access takes twice as that of read access, we have a total of $(1 \times 4 \times 2 + 1 + 2 + 2 \times 2) \times 500 = 7,500$ (500 occurrences of the operation).
19. We have 1 read access to the Client entity, 1 write access to the PromRel relationship and another 1 write access to the Promo Code entity. Since we assume that a write access costs twice more than a read access, we have $(1 + 2 + 2) \times 500 = 2,500$ (500 occurrences of the operation).

Table Of Accesses								
Concept	E/R	Access	W/R		Concept	E/R	Access	W/R
Operation 1					Operation 2			
Rating	R	19,880	R		Music	E	125	R
Event	E	4	R		Sing	R	20,000	R
Total		59,652			Ban	R	250	R
					Crime Convict	E	250	R
Operation 3					Artiste	E	1,000	R
Ad Event	R	10	R		Total		21,625	

MediaRel	R	3	R					
Total		13			Operation 4			
					Advertisement Event	E	10	R
Operation 5					Media Event	R	10	R
Host	R	2	R		Advertisement Instance	E	70	R
Organise	R	16	R		Media Instance	R	70	R
Organiser/DJ	E	4	R		Advertisement Site	E	10	R
Total		66			Media Site	R	10	R
					Total		140	
Operation 6								
Artiste	E	1,000	R		Operation 7			
Ban	R	1,000	R		DirectF	R	360	R
Crime Convict	E	1,000	R		Act	R	900	R
Total		3,000			Artiste	E	180	R
					Ban	R	20	R
Operation 8					Total		1,460	
Promo Code	E	60	R					
PromRel	R	60	R		Operation 9			
Client	E	60	R		Ad Site	R	250	R

Total		360			Advertisement Business	E	250	R
					Total		2,500	
Operation 10								
Accomm Reserve	R	1,000	R		Operation 11			
Locate Accom	R	40	R		AgreementF	R	5,000	R
City	E	20	R		Supply	E	5,000	R

Total		1,060			SupplyC	R	5,000	R
					Business/Company	E	60	R
Operation 12					Total		150,600	
Client	E	70	R					
LiveC	R	70	R		Operation 13			
BuyE	R	70	R		Client	E	1,000	R
Host	R	70	R		Person Reserve	R	1,000	R
Total		560			Accomm Reserve	R	1,000	R
					SeatP	R	5,000	R
Operation 14					SeatS	R	5,000	R
Artiste	E	4,000	R		Total		13,000	
Sing	R	80,000	R					
Play	R	5,000	R		Operation 15			
Total		445,000			Ban	R	1,000	R
					Sing	R	20,000	R
Operation 16					Crime Convict	E	1,000	R
Insure Site	R	50			Total		44,000	
Business/Company	E	20						
LocateComp	R	20			Operation 17			
City	E	20			Film	E	100	R
Total		110			Act	R	5,000	R
					Sing	R	20,000	R
Operation 18					Music	E	125	R
Client	E	1	W		Total		151,350	
BuyP	R	1	W					
Buy Food	E	1	W		Operation 19			

BuyF	R	1	W		Client	E	1	R
Food & Drinks	E	1	R		PromRel	R	1	W
IngFood	R	2	W		Promo Code	E	1	W
Ingredient	E	2	R		Total		2,500	
Total		7,500						

3. Direct Translation to the Relational Model

Translations of Entities and Relationships into Relational Schemas

First of all, we would like to remove redundant data. As we can see from the schema, if an entity is partly identified by another entity, then the relationship between the two is already represented - so we can remove such relationships' relational schemas. In our case, we have three relationships that satisfy the condition: the Locate relationship between City and Site, the LocateAccomm relationship between City and Accommodation, and lastly the Rel Event relationship between Event and Event Instance. So we can remove them.

Secondly, some relations have composite keys, we can replace those keys with self-generating codes. Of them, we have SITE(Name, CityName, County, Capacity, Addr, EType) now uniquely identified by an ID as SITE(ID, Name, CityName, County, Capacity, Addr, EType) and ACCOMMODATION(Name, CityName, County, Cost, Addr, EType) also identified by an ID as ACCOMMODATION(ID, Name, CityName, County, Cost, Addr, EType). For EVENTINSTANCE(Code, Type, SDateTime, FDateTime), the code identifies uniquely within a type, but now we generalise this to be a sole identify thereof as EVENTINSTANCE(ID, Type, SDateTime, FDateTime).

Lastly, for CITY and MEDIA, we did not wish to change their composite keys because many operations that require their composite key attributes can access them through their relationships without directly accessing the entities themselves and thereby reducing the number of accesses. Unfortunately, In postgresql, it does not allow a reference from one relation's attributes to another relation's composite keys. For example, since city and media

have 2 attributes each for their respective composite keys, any other relation's attributes cannot have a foreign key to either city or media (one can reference a key, but not a composite key). Hence, by introducing self generating IDs, we are forced to have more access for some operations that require the city's name and county and the media's name and type. So we have the following: CITY(ID, Name, County, Region) and MEDIA(ID, Type, Name). However, by introducing ID's for the CITY and MEDIA, we have cut down the storage space further from 2,572,292 bytes to 2,450,492 bytes, a difference of 121,800 bytes = 121.8 kbytes.

Thus, we have:

1.	INGREDIENT	(<u>ID</u> , Name, Type)
2.	IngFood	(<u>Ingr</u> , <u>FoodDrinks</u>)
3.	FOODDRINKS	(<u>ID</u> , Type, Cost, Qnt, Name, <u>EType</u>)
4.	AgreementF	(<u>Supply</u> , FoodDrinks)
5.	SUPPLY	(<u>ID</u> , DateSupplied)
6.	SupplyC	(<u>Supply</u> , Business)
7.	BUSINESS	(<u>ID</u> , Name, BusinessType, Addr, <u>EType</u>)
8.	BuyF	(<u>BuyFood</u> , FoodDrinks)
9.	BUYFOOD	(<u>Code</u> , DateBuyFood)
10.	BuyP	(<u>BuyFood</u> , Client)
11.	CLIENT	(<u>SSN</u> , Age, Email, sex, FName, Lname)
12.	Prom Rel	(<u>PromoCode</u> , Client)
13.	PROMOCODE	(<u>PromID</u> , Type, SDate, Edate, UsedOrNot, <u>EType</u>)
14.	BuyE	(<u>EventInstanceID</u> , Client, BuyDate)
15.	Rating	(<u>Client</u> , <u>EventInstanceID</u> , Date, RateVal)
16.	LiveC	(<u>Client</u> , CityID)
17.	PersonReserve	(<u>BookAccomm</u> , Client)
18.	BOOKACCOMM	(<u>ID</u> , Date)
19.	AccommReserve	(<u>BookAccomm</u> , AccomID)
20.	SeatP	(<u>BookManyTimes</u> , Client)
21.	BOOKMANYTIMES	(<u>ID</u> , Cost, Type, Duration, SdateTime)
22.	SeatS	(<u>BookManyTimes</u> , SiteID)
23.	ORGANISER/DJ	(<u>SSN</u> , Age, Email, sex, FName, Lname, Salary, Hiredate, License)
24.	Organise	(<u>DJ</u> , <u>EventInstanceID</u>)
25.	LiveO	(<u>DJ</u> , CityID)

26.	LiveD	(<u>Director</u> , CityID)
27.	Work	(<u>DJ</u> , <u>SiteID</u>)
28.	DirectS	(<u>SiteID</u> , Director)
29.	DIRECTOR	(<u>SSN</u> , Age, Email, sex, FName, Lname, Salary, Hiredate)
30.	Host	(<u>EventInstanceID</u> , SiteID)
31.	AdSiteMedia	(<u>ADSITE</u> , SiteID)
32.	EVENTINSTANCE	(<u>Code</u> , Type, SDateTime, FDateTime)
33.	AdInstance	(<u>ADINSTANCE</u> , EventInstanceID)
34.	EVENT	(<u>Type</u> , Cost)
35.	AdEvent	(<u>ADEVENT</u> , EventType)
36.	ADVERTISEMENT EVENT	(<u>Code</u> , Cost, Duration, StartDateTime, EndDateTime)
37.	ADVERTISEMENT INSTANCE	(<u>Code</u> , Cost, Duration, StartDateTime, EndDateTime)
38.	ADVERTISEMENT SITE	(<u>Code</u> , Cost, Duration, StartDateTime, EndDateTime)
39.	MediaEvent	(<u>ADEVENT</u> , MediaID)
40.	MediaInstance	(<u>ADINSTANCE</u> , MediaID)
41.	MediaSite	(<u>ADSITE</u> , MediaID)
42.	MEDIA	(<u>ID</u> , Type, Name)
43.	FACILITY	(<u>Type</u>)
44.	FacRel	(<u>Facility</u> , <u>AccomID</u>)
45.	ACCOMODATION	(<u>ID</u> , Name, CityID, Cost, Addr, EType)
46.	CITY	(<u>ID</u> , Name, County, Region)
47.	LocateComp	(<u>Business</u> , CityID)
48.	SITE	(<u>ID</u> , Name, CityID, Capacity, Addr, EType)
49.	InsureSite	(<u>SiteID</u> , Business)
50.	AdBusiness	(<u>AdvertisementBusiness</u> , Business)
51.	ADVERTISEBUSINESS	(<u>Code</u> , Cost, Duration, SDateTime, EDateTime)
52.	AdSite	(<u>AdvertisementBusiness</u> , SiteID)
53.	Play	(<u>SiteID</u> , <u>Music</u>)
54.	Watch	(<u>SiteID</u> , <u>Film</u>)
55.	MUSIC	(<u>Code</u> , Name, Type)
56.	Sing	(<u>Music</u> , <u>ArtName</u>)
57.	FILM	(<u>Code</u> , Name, Type)
58.	Act	(<u>Film</u> , <u>ArtName</u>)
59.	DirectF	(<u>Film</u> , ArtName)
60.	ARTISTE	(<u>ArtName</u> , Rank, Age, EType)

- | | | |
|-----|--------------|---|
| 61. | Ban | (<u>CrimeC</u> , ArtName) |
| 62. | CRIMECONVICT | (<u>Code</u> , CrimeType, Severity, DateConvicted) |

Referential Integrity Constraints for the ER Schema

1. IngFood[Ingr] references INGREDIENT[ID] and IngFood[FoodDrinks] references FOODDRINKS[ID]
2. AgreementF[Supply] references SUPPLY[ID] and AgreementF[FoodDrinks] references FOODDRINKS[ID]
3. SupplyC[Supply] references SUPPLY[ID] and SupplyC[Business] references BUSINESS[ID]
4. BuyF[BuyFood] references BUYFOOD[Code] and BuyF[FoodDrinks] references FOODDRINKS[ID]
5. BuyP[BuyFood] references BUYFOOD[Code] and BuyP[Client] references CLIENT[SSN]
6. PromRel[PromoCode] references PROMOCODE[PromID] and PromRel[Client] references CLIENT[SSN]
7. BuyE[EventInstanceID] references EVENTINSTANCE[Code] and BuyE[Client] references CLIENT[SSN]
8. Rating[EventInstanceID] references EVENTINSTANCE[Code] and Rating[Client] references CLIENT[SSN]
9. LiveC[CityID] references CITY[ID]and LiveC[Client] references CLIENT[SSN]
10. LiveO[CityID] references CITY[ID] and LiveO[DJ] references ORGANISER/DJ[SSN]
11. LiveD[CityID] references CITY[ID]and LiveD[Director] references DIRECTOR[SSN]
12. PersonReserve[BookAccomm] references BOOKACCOMM[ID] and PersonReserve[Client] references CLIENT[SSN]
13. AccomReserve[BookAccomm] references BOOKACCOMM[ID] and AccomReserve[AccomID] references ACCOMMODATION[ID]
14. SeatP[BookManyTimes] references BOOKMANYTIMES[ID] and SeatP[Client] references CLIENT[SSN]
15. SeatS[BookManyTimes] references BOOKMANYTIMES[ID] and SeatS[SiteID] references SITE[ID]
16. Organise[EventInstanceID] references EVENTINSTANCE[Code] and Organise[DJ] references ORGANISER/DJ[SSN]

17. Work[SiteID] references SITE[ID] and Work[DJ] references ORGANISER/DJ[SSN]
18. DirectS[SiteID] references SITE[ID] and DirectS[Director] references DIRECTOR[SSN]
19. Host[EventInstanceID] references EVENTINSTANCE[Code] and Host[SiteID] references SITE[ID]
20. AdSiteMediaRel[SiteID] references SITE[ID] and AdSiteMediaRel [ADSITE] references ADSITE[Code]
21. AdInstanceRel[EventInstanceID] references EVENTINSTANCE[Code] and AdInstanceRel[ADINSTANCE] references ADINSTANCE[Code]
22. AdEventRel[EventType] references EVENT[Type] and AdEventRel[ADEVENT] references ADEVENT[Code]
23. MediaEvent[ADEVENT] references ADEVENT[Code] and MediaEvent[MediaID] references MEDIA[ID]
24. MediaInstance[ADINSTANCE] references ADINSTANCE[Code] and MediaInstance[MediaID] references MEDIA[ID]
25. MediaSite[ADSITE] references ADSITE[Code] and MediaSite[MediaID] references MEDIA[ID]
26. FacRel[Facility] references FACILITY[Type] and FacRel[AccomID] references ACCOMMODATION[ID]
27. LocateComp[Business] references BUSINESS[ID] and LocateComp[CityID] references CITY[ID]
28. InsureSite[Business] references BUSINESS[ID] and InsureSite[SiteID] references SITE[ID]
29. AdBusiness[Business] references BUSINESS[ID] and AdBusiness[AdvertisementBusiness] references ADVERTISEBUSINESS[Code]
30. AdSite[SiteID] references SITE[ID] and AdSite[AdvertisementBusiness] references ADVERTISEBUSINESS[Code]
31. Play[SiteID] references SITE[ID] and Play[Music] references MUSIC[Code]
32. Watch[SiteID] references SITE[ID] and Watch[Film] references FILM[Code]
33. Sing[ArtName] references ARTISTE[ArtName] and Sing[Music] references MUSIC[Code]
34. Act[ArtName] references ARTISTE[ArtName] and Act[Film] references FILM[Code]
35. DirectF[ArtName] references ARTISTE[ArtName] and DirectF[Film] references FILM[Code]

36. Ban[ArtName] references ARTISTE[ArtName] and Ban[CrimeC] references CRIMECONVICT[Code]

The amount of Storage that would be used to store the Relational Schemas

Here, we assume that every attribute including codes/IDs takes 4 bytes.

Concept	Number Of Attributes	Volume	Storage Used in Bytes
Client	6	9,940	238,560
Director	8	10	320
Organiser/DJ	9	50	1,800
Food & Drinks	6	4,000	96,000
Ingredient	3	20	240
Promo code	6	500	12,000
Event instance	4	100	1,600
Event	2	5	40
Advertisement Event	5	10	200
Advertisement Instance	5	50	1,000
Advertisement Site	5	10	200
Media	3	10	120
Site	6	50	1,200
Film	3	400	4,800
Artiste	4	4,000	64,000
Music	3	500	6,000
Crime convict	4	1,000	16,000
Book many times	5	5,000	100,000
Accommodation	6	40	960
Facility	1	3	12
Book accom	2	1,000	8,000

Advertisement Business	5	250	5,000
Buy Food	2	15,000	120,000
Supply	2	5,000	40,000
Business/Company	5	100	2,000
City	4	20	320
Ban	2	1,000	8,000
DirectF	2	400	3,200
Act	2	20,000	160,000
Sing	2	80,000	640,000
Play	2	5,000	40,000
Watch	2	200	1,600
Ad_Event	2	10	80

Ad Instance	2	50	400
Ad Site Media	2	10	80
Media Event	2	10	80
Media Instance	2	70	560
Media Site	2	10	80
Host	2	100	800
BuyE	3	70	840
Rating	4	19,880	318,080
Organise	2	100	800
PromRel	2	500	4,000
DirectS	2	50	400
Work	2	200	1,600
Seat P	2	5,000	40,000
Seat S	2	5,000	40,000
Person Reserve	2	1,000	8,000

Accomm Reserve	2	1,000	8,000
LiveC	2	9,940	79,520
LiveO	2	50	400
LiveD	2	10	80
LocateComp	2	100	320
Insure Site	2	50	400
AD Site	2	250	2,000
AD Business	2	250	2,000
BuyP	2	15,000	120,000
BuyF	2	15,000	120,000
AgreementF	2	5,000	40,000
SupplyC	2	5,000	40,000
IngFood	2	6,000	48,000
FacRel	2	40	320
TOTAL			2,450,492 = 2.45MB

4. Restructuring of the Relational Scheme

Restructuring of Relational Schemas

a). [One-to-many relationships](#)

It is one in which the cardinalities between 2 entities and a relationship have a maximum of 1 on one side and a maximum of N on the other side. It means that the key of the relationship is exactly the same as the key of the entity that participates with maximum cardinality of one. Well, if we merge the attributes of the relationship including its key to that of the entity, we still can get null values because the participation may be optional (0,1). In that case, we

have to consider the table of accesses and volumes to choose which option suits our needs best. However, if the cardinality is (1,1), that is both compulsory participation and a maximum of 1, then the entity and the relationship have the same key and we can therefore be sure that there is no risk of redundancy merging them in a single relation. This is because there is a one-to-one correspondence between the respective instances.

For example, in the DirectF relation, the key consists of only the identifier of FILM because the cardinalities of the relationship tell us that each FILM has only one Director. At this point, the relations DirectF and FILM have the same key (the code of the film) and we can therefore merge them in a single relation with no risk of redundancy. This is because there is a one-to-one correspondence between the respective instances.

However, there is obviously a referential constraint between the attribute ArtName (that we will include in the FILM relation for discarding the DirectF relation) and the ARTISTE relation. Note that the participation of the FILM entity is mandatory. If it were optional, then it is possible to have FILMs that have no Director and thus it is possible to have null values in the FILM relation on the attribute ArtName.

The same analogy can be applied to all the other (1,1) to (x,N) relationships in our restructured schema without further explanation because they all follow as the example above. We will therefore merge those relations into the relation that participates with (1,1).

There is also a one-to-many relationship BuyE in which the entity (Event Instance) that participates with maximum cardinality of one has optional participation; that is (0,1). In this case, unlike the (1,1) case, we can have null values. Here, we can merge the relationship BuyE into the entity relation or we can leave the relationship without merging. Which option should we choose: the former or the latter? Well, let's calculate the costs of operation and storage used by potential null values and then choose the best according to our needs. Let's consider operation 12. From the table of accesses, there are 70 accesses to the BuyE relationship and 70 to the Host relationship that connects the Event Instance and Site entities. But since we will merge the Host relation into the Event Instance relation because of (1,1) cardinality, we will have 70 accesses to the Event Instance relation. Now, if we merge the BuyE into the Event Instance, we don't need any separate access to BuyE, so we will reduce the number of accesses by 70. But since operation 12 occurs twice per week, we have $70 \times 2 = 140$ less accesses when merged compared to when not merged. What about the storage wasted due to null values? Well, great things come at a cost. There are 2 attributes that would be included in the Event Instance relation, SSN and BuyDate, each of

which takes 4 bytes. From the table of volumes, BuyE occurs on average 70 times while Event Instance occurs on average 100 times - so there is a difference of 30 ($30 \times 8 \text{ bytes} = 240 \text{ bytes}$ of storage due to possible null values). Which one is better: 140 less accesses or 240 bytes more? Well, since 240 bytes is insignificant compared to 140 less accesses in our view, we therefore merge the BuyE into the Event Instance.

There seems to be another merging on the way. We can see that both SUPPLY with attributes ID and DateSupplied, BUYFOOD with attributes Code and DateBuyFood, and BOOKACCOMM with attributes ID and DateBookAccomm have the same number of attributes and in the same domain. Why not merge them? First of all, they connect different concepts. Secondly, none of our operations relate them together, so even if they were merged as one, we would have done horizontal splitting to partition them. Lastly, if we were to merge them, we would have to include an ad-hoc attribute in order to distinguish between them. This attribute alone would take up a storage space of 5,000 for SUPPLY plus 15,000 for BUYFOOD plus 1,000 for BOOKACCOMM (taken from table of volumes) - a total of $(5,000 + 15,000 + 1,000) \times 4 \text{ bytes} = 84 \text{ kbytes}$.

For the possible merging of the entities ORGANISER/DJ and DIRECTOR, we did already clearly explain in the “removing of generalisation” section why we won’t merge them.

Thus, we have the following restructured relational schemas:

01. INGREDIENT	(<u>ID</u> , Name, Type)
02. IngFood	(<u>Ingr</u> , <u>FoodDrinks</u>)
03. FOODDRINKS	(<u>ID</u> , Type, Cost, Qnt, Name, EType)
04. SUPPLY	(<u>ID</u> , FoodDrinks, Business, DateSupplied)
05. BUSINESS	(<u>ID</u> , CityID, Name, BusinessType, Addr, EType)
06. BUYFOOD	(<u>Code</u> , Client, FoodDrinks, DateBuyFood)
07. CLIENT	(<u>SSN</u> , CityID, Age, Email, sex, FName, Lname)
08. PROMOCODE	(<u>PromID</u> , Client, Type, SDate, Edate, UsedOrNot, EType)
09. Rating	(<u>Client</u> , EventInstanceID, Date, RateVal)
10. BOOKACCOMM	(<u>ID</u> , Client, AccomID, Date)
11. BOOKMANYTIMES	(<u>ID</u> , Client, SiteID, Cost, Type, Duration, SdateTime)
12. ORGANISER/DJ	(<u>SSN</u> , CityID, Age, Email, sex, FName, Lname, Salary, Hiredate, License)
13. Work	(<u>DJ</u> , <u>SiteID</u>)

14. DIRECTOR	(<u>SSN</u> , , CityID, Age, Email, sex, FName, Lname, Salary, Hiredate)
15. EVENTINSTANCE	(<u>Code</u> , Type, DJ, Client, BuyDate , SiteID, SDateTime, FDateTime)
16. EVENT	(<u>Type</u> , Cost)
17. ADEVENT	(<u>Code</u> , EventType, MediaID, Cost, Duration, StartDateTime, EndDateTime)
18. ADINSTANCE	(<u>Code</u> , EventInstanceID, MediaID, Cost, Duration, StartDateTime, EndDateTime)
19. ADSITE	(<u>Code</u> , SiteID, MediaID, Cost, Duration, StartDateTime, EndDateTime)
20. MEDIA	(<u>ID</u> , Type, Name)
21. FACILITY	(<u>Type</u>)
22. FacRel	(<u>Facility</u> , <u>AccomID</u>)
23. ACCOMODATION	(<u>ID</u> , Name, CityID, Cost, Addr, EType)
24. SITE	(<u>ID</u> , Name, CityID, Director, BusinessInsure, Capacity, Addr, <u>EType</u>)
25. CITY	(<u>ID</u> , Name, County, Region)
26. ADVERTISEMENTBUSINESS	(<u>Code</u> , Business, SiteID, Cost, Duration, SDateTime, EDateTime)
27. Play	(<u>SiteID</u> , <u>Music</u>)
28. Watch	(<u>SiteID</u> , <u>Film</u>)
29. MUSIC	(<u>Code</u> , Name, Type)
30. Sing	(<u>Music</u> , <u>ArtName</u>)
31. FILM	(<u>Code</u> , DirectorF, Name, Type)
32. Act	(<u>Film</u> , <u>ArtName</u>)
33. ARTISTE	(<u>ArtName</u> , Rank, Age, EType)
34. CRIMECONVICT	(<u>Code</u> , ArtName, CrimeType, Severity, DateConvicted)

Referential Integrity Constraints for the Restructured Relational schemas

01. IngFood[Ingr] references INGREDIENT[ID] and IngFood[FoodDrinks] references FOODDRINKS[ID]
02. SUPPLY[Business] references BUSINESS[ID] and SUPPLY[FoodDrinks] references FOODDRINKS[ID]

03. BUSINESS[CityID] references CITY[ID]
04. BUYFOOD[FoodDrinks] references FOODDRINKS[ID] and BUYFOOD[Client] references CLIENT[SSN]
05. CLIENT[CityID] references CITY[ID]
06. PROMOCODE[Client] references CLIENT[SSN]
07. Rating[EventInstanceID] references EVENTINSTANCE[Code] and Rating[Client] references CLIENT[SSN]
08. BOOKACCOMM[Client] references CLIENT[SSN] and BOOKACCOMM[AccomID] references ACCOMMODATION[ID]
09. BOOKMANYTIMES[Client] references CLIENT[SSN] and BOOKMANYTIMES[SiteID] references SITE[ID]
10. ORGANISER/DJ[CityID] references CITY[ID]
11. DIRECTOR[CityID] references CITY[ID]
12. Work[SiteID] references SITE[ID] and Work[DJ] references ORGANISER/DJ[SSN]
13. EVENTINSTANCE[DJ] references ORGANISER/DJ[SSN], EVENTINSTANCE[Client] references CLIENT[SSN] and EVENTINSTANCE[SiteID] references SITE[ID]
14. ADEVENT[EventType] references EVENT[Type] and ADEVENT[MediaID] references MEDIA[ID]
15. ADINSTANCE[EventInstanceID] references EVENTINSTANCE[Code] and ADINSTANCE[MediaID] references MEDIA[ID]
16. ADSITE[SiteID] references SITE[ID] and ADSITE[MediaID] references MEDIA[ID]
17. FacRel[Facility] references FACILITY[Type] and FacRel[AccomID] references ACCOMMODATION[ID]
18. ACCOMODATION[CityID] references CITY[ID]
19. SITE[CityID] references CITY[ID], SITE[Director] references DIRECTOR[SSN] and SITE[BusinessInsure] references BUSINESS[ID]
20. ADVERTISEMENTBUSINESS[Business] references BUSINESS[ID] and ADVERTISEMENTBUSINESS[SiteID] references SITE[ID]
21. Play[SiteID] references SITE[ID] and Play[Music] references MUSIC[Code]
22. Watch[SiteID] references SITE[ID] and Watch[Film] references FILM[Code]
23. Sing[ArtName] references ARTISTE[ArtName] and Sing[Music] references MUSIC[Code]
24. FILM[DirectorF] references ARTISTE[ArtName]
- 25.

26. Act[ArtName] references ARTISTE[ArtName] and Act[Film] references FILM[Code
]

27. CRIMECONVICT[ArtName] references ARTISTE[ArtName]

The Amount of Storage that would be used to Store the Restructured Relational Schemas

Here, we assume that every attribute including codes/IDs takes 4 bytes.

Concept	Number Of Attributes	Volume	Storage Used in Bytes
Client	7	9,940	278,320
Director	9	10	360
Organiser/DJ	10	50	2,000
Food & Drinks	6	4,000	96,000
Ingredient	3	20	240
Promo code	7	500	14,000
Event instance	8	100	3,200
Event	2	5	40
Advertisement Event	7	10	280
Advertisement Instance	7	50	1,400
Advertisement Site	7	10	280
Media	3	10	120
Site	8	50	1,600
Film	4	400	6,400
Artiste	4	4,000	64,000
Music	3	500	6,000
Crime convict	5	1,000	20,000
Book many times	7	5,000	140,000
Accommodation	6	40	1,120
Facility	1	3	12

Book accom	4	1,000	16,000
Advertisement Business	7	250	7,000
Buy Food	4	15,000	240,000
Supply	4	5,000	80,000
Business/Company	6	100	2,400
City	4	20	240
Act	2	20,000	160,000
Sing	2	80,000	640,000
Play	2	5,000	40,000
Watch	2	200	1,600
Rating	4	19,880	397,600
Work	2	200	1,600
IngFood	2	6,000	48,000
FacRel	2	40	320
TOTAL			2,190,532 = 2.2MB

5. Database specification in SQL

SQL Tables Construction, Triggers and Queries

As required in the specification that we must include these sql files in a zip folder instead of pasting them here, we therefore included them in the zip folder that we submitted but also the links are provided below:

- [Database Schema in SQL](#)
- [Implementation of Business Rules Using Triggers](#)
- [A file with both Natural Language and SQL Queries](#)